United States Patent [19]

Koch

[11] **4,375,279**

[45] **Mar. 1, 1983**

[54] **BOBBIN ASSEMBLY**

[75] Inventor: **Keith E. Koch**, Tremont, Ill.

[73] Assignee: **Caterpillar Tractor Co.**, Peoria, Ill.

[21] Appl. No.: **278,504**

[22] PCT Filed: **Mar. 23, 1981**

[86] PCT No.: **PCT/US81/00377**

§ 371 Date: **Mar. 23, 1981**

§ 102(e) Date: **Mar. 23, 1981**

[51] **Int. Cl.**[3] **B65H 59/04**

[52] **U.S. Cl.** **242/156;** 242/75.4; 242/129.8; 57/13; 87/21; 188/71.9; 188/83

[58] **Field of Search** ..... 242/156, 156.2, 129.8, 242/75.4, 55.3, 54 R, 86.7, 99; 57/9, 13, 14, 15, 16, 17; 87/21, 56, 57; 188/71.9, 83, 170, 196 M

[56] **References Cited**

U.S. PATENT DOCUMENTS

2,277,134	3/1942	Nelson	242/156 X
2,385,479	9/1945	Underhill	242/156 X
2,405,446	8/1946	Perrault	242/75.4 X
2,445,607	7/1948	Ghetto	242/156 X
3,137,985	6/1964	Bailey	57/13
3,439,483	4/1969	Brown	57/16 X
3,590,567	7/1971	Bonikowski et al.	57/3
3,720,054	3/1973	Haehnel et al.	57/13 X
3,907,229	9/1975	Iannucci et al.	242/156 X

FOREIGN PATENT DOCUMENTS

2807111	8/1978	Fed. Rep. of Germany	242/156
631789	9/1927	France	242/156

Primary Examiner—Stanley N. Gilreath

Attorney, Agent, or Firm—Robert A. McFall

[57] **ABSTRACT**

A bobbin assembly (**10**) is disclosed for simultaneously dispensing a plurality of wires and controllably maintaining a predetermined tension on the wires.

In the construction of a high pressure, multiple-ply, wire reinforced hose, it is necessary that each of the wires be applied at a uniform, predetermined tension. The present invention solves this problem by providing each spool assembly (**12**) of a multiple spool bobbin assembly (**10**) with an internally disposed adjustable brake assembly (**22**). The brake assembly (**22**) of the present invention imparts a controllable and uniform resistance to the rotation of a supply reel (**20**) in each of the spool assemblies (**12**). The present invention is particularly useful in the construction of high pressure hydraulic hose products.

13 Claims, 4 Drawing Figures

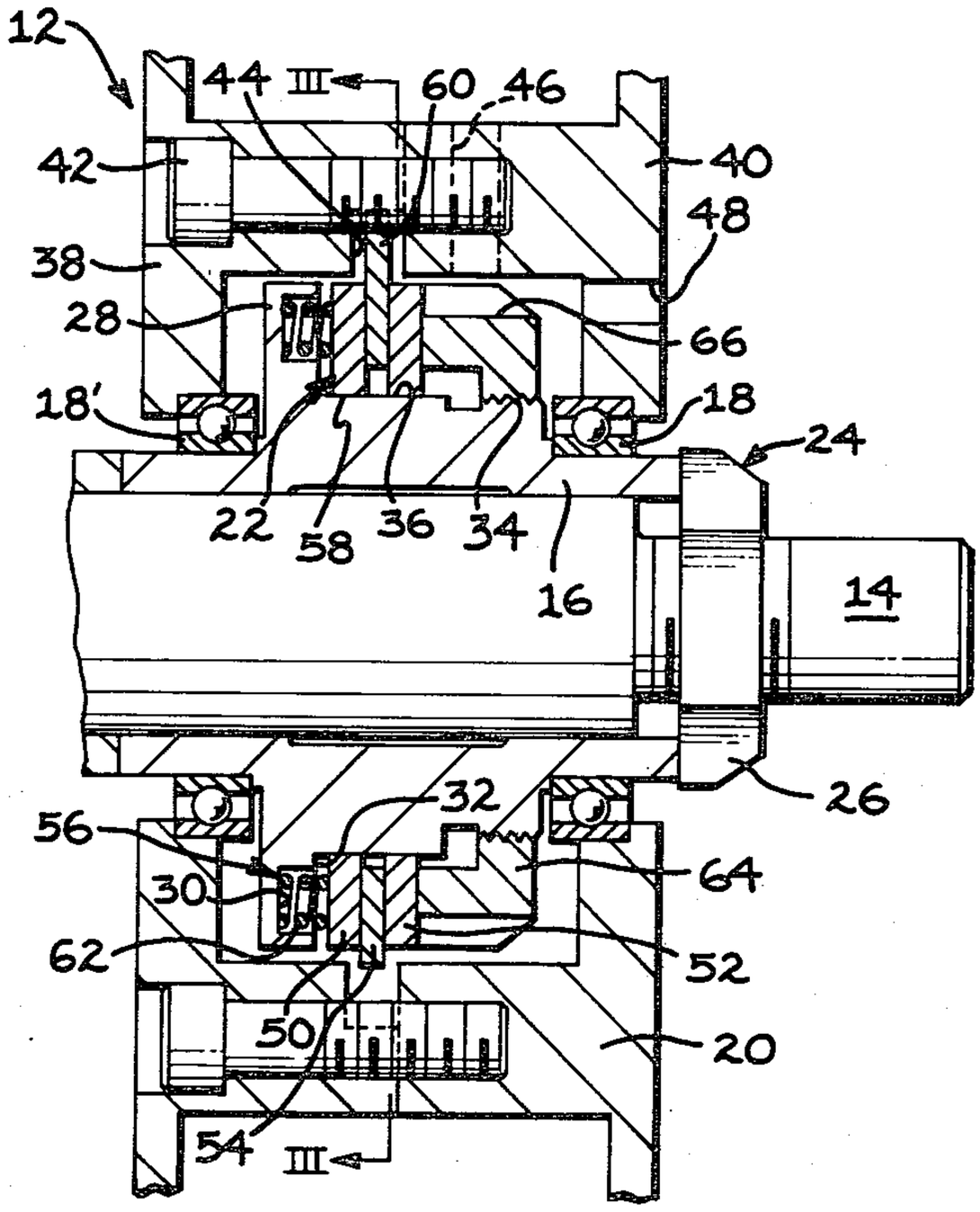
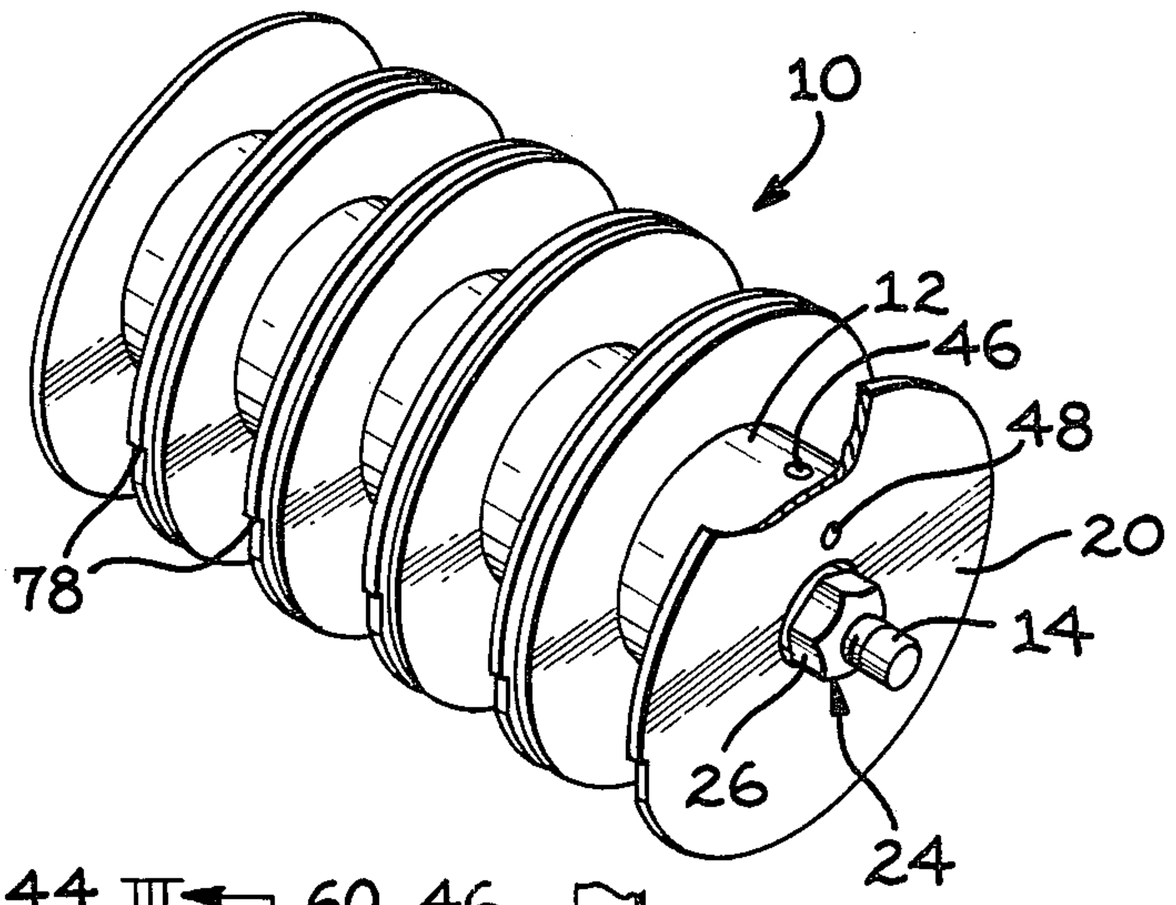


FIG 1


10
12
46
48
20
14
78
26
24

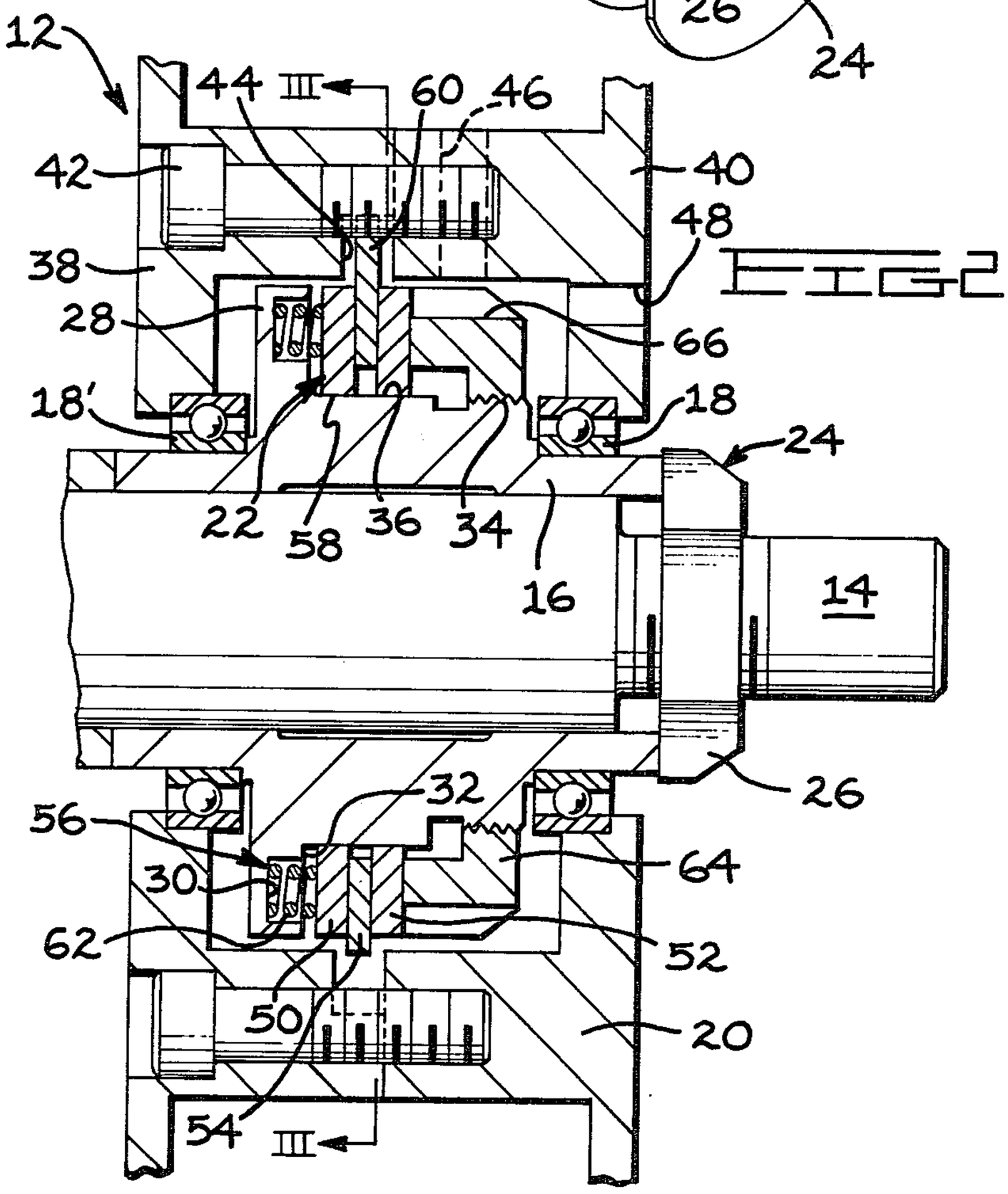

12
44
III
60
46
42
40
48
38
28
66
18'
18
24
22
58
36
34
16
14
26
56
32
64
30
62
52
50
20
54
III

FIG 2

FIG-3

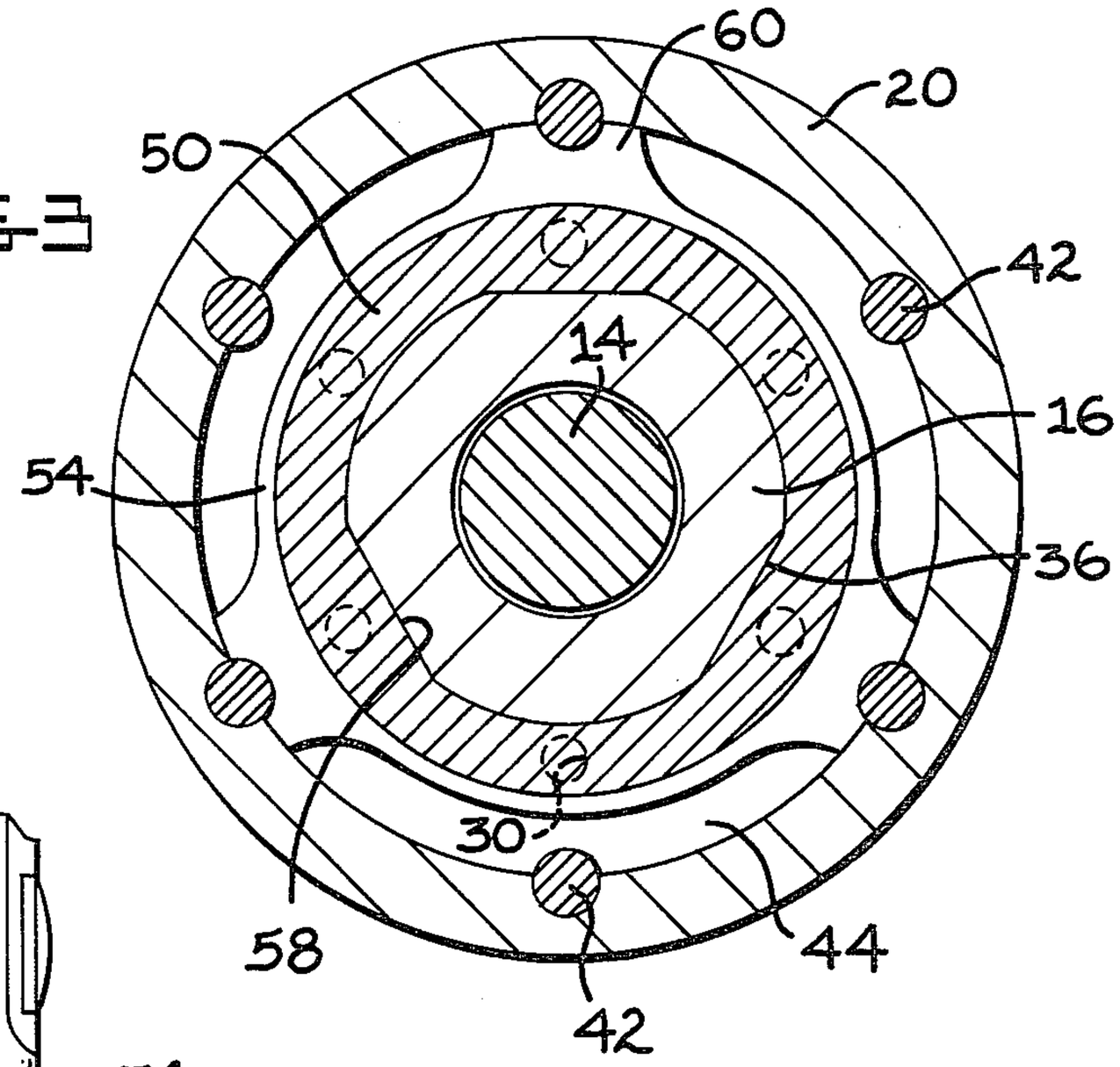
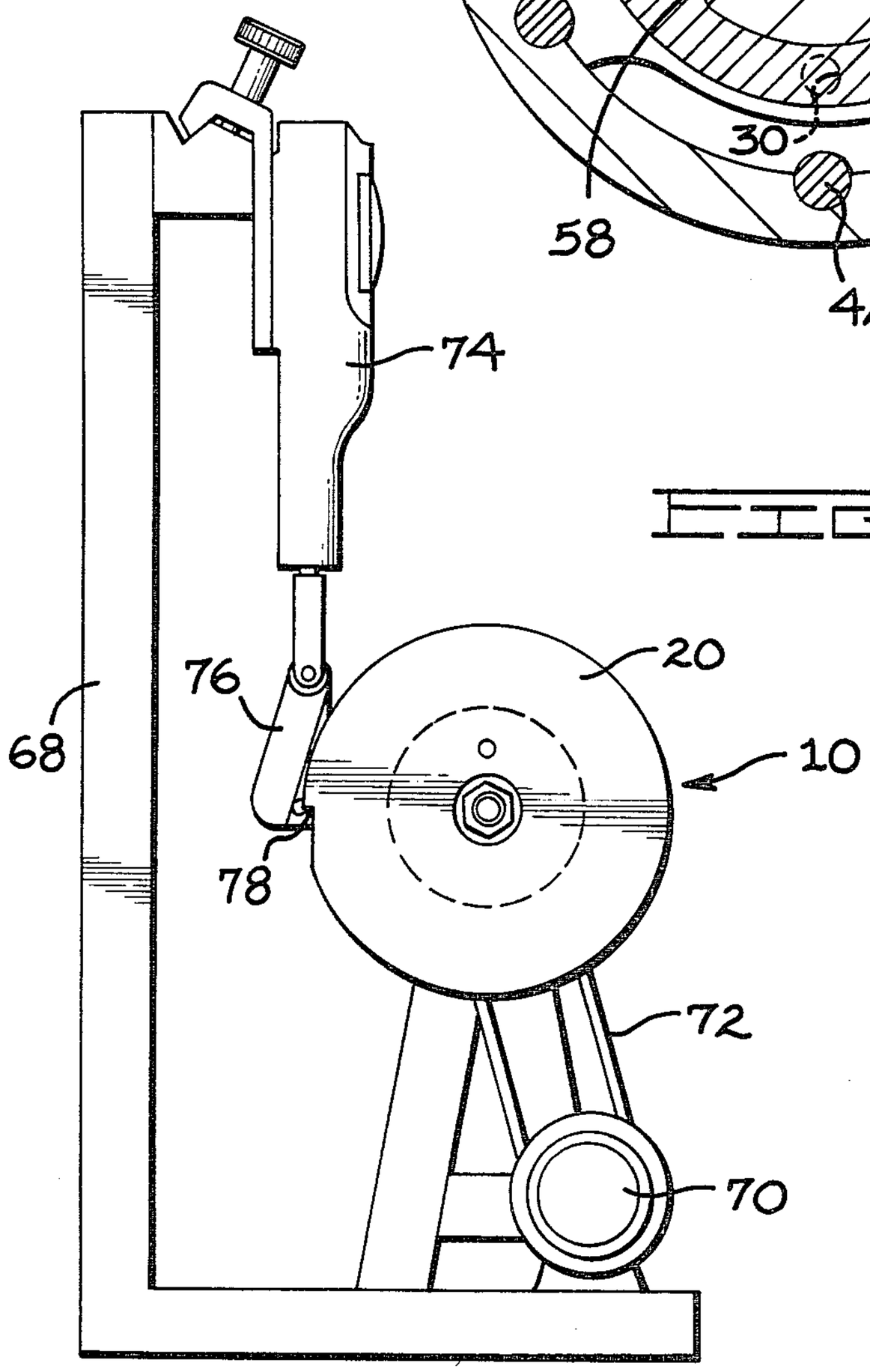


FIG-4



BOBBIN ASSEMBLY

DESCRIPTION

Technical Field

This invention relates generally to a bobbin assembly and more particularly to a bobbin assembly for simultaneously disposing a plurality of wires and controllably maintaining a predetermined tension of low magnitude on the wires.

Background Art

In the construction of multiple ply, wire-wound articles, such as high pressure hydraulic hose, it is highly desirable that each individual wire be equally tensioned and that each multiple wire ply of the construction be applied at a predetermined, uniform tension. In the construction of a typical high pressure hose as many as 100 to 150 individual wires may be simultaneously wound about a mandrel. If each wire is not uniformly tensioned, the lesser-tensioned strands will have a tendency to lie above the plane of adjacent wires, and higher-tensional wires will have a tendency to become buried in preceding plys and lie below adjacent wires. Unequal wire tension results in non-uniform wire lay, poor radial positioning of individual strands, and a less than desirable finished product.

In response to the desire to construct high quality wire-wound articles, a number of attempts have been made to control the tension of wire strands during construction of such articles. One approach has been to employ a spring biased take-up device between the wire supply reel and the article being constructed. Such devices are effective for controlling slack in the wire but generally provide inadequate control of wire tension.

Other attempts to control wire tension are directed to the provision of various supply reel braking devices such as the spring-loaded brake shoes disclosed in U.S. Pat. No. 3,720,054, issued to Rudolf H. Haeknel, et al, on Mar. 13, 1973. Supply reel braking devices have, heretofore, been only limitedly successful in controlling wire tension. Generally, currently known braking devices are bulky, do not provide equal braking action throughout each revolution of the supply reel, and suffer from a variation of tension control in response to the rotational speed of the reel. In addition, current braking devices require frequent readjustment during operation and do not lend themselves to incorporation in multiple reel bobbin assemblies.

The present invention is directed to overcoming one or more of the problems as set forth above, and includes a bobbin assembly having a plurality of spool assemblies mounted on a common shaft. Each of the spool assemblies has a wire supply reel and an adjustable brake assembly internally disposed within the reel. The brake assembly controllably maintains a uniform predetermined tension on the wire as the wire is dispensed to an article.

DISCLOSURE OF THE INVENTION

In accordance with one aspect of the present invention, a bobbin assembly for dispensing a plurality of wires and controllably maintaining a predetermined tension on the wires, includes a shaft, a plurality of hubs mounted on the shaft in a fixed relationship with the shaft, and a plurality of reels each rotatably mounted on a respective hub. The bobbin assembly also includes a

friction member positioned between a pair of reaction members on each of the hubs and a means for biasing at least one of the reaction members toward an associated friction member.

In the construction of a high quality, multiple-ply, wire reinforced hose, it is required that each of the individual strands of wire be supplied to a forming mandrel at a uniform predetermined tension. The present invention solves this problem by providing each spool of a multiple spool bobbin assembly with an internally positioned, adjustable brake assembly. The brake assembly imparts controllable and uniform resistance to the rotation of a supply reel and maintains a uniform tension on the wire throughout each revolution of the reel.

The present invention provides a bobbin assembly that enables the construction of a wire-wound article having a more uniform wire lay, i.e., less high or buried wires, and improved radial positioning of the applied wires. The present invention also provides an improved, easily serviceable and adjustable brake assembly for maintaining a uniform tension of very low magnitude on the wire during a single revolution of the reel.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an isometric view of a multiple spool bobbin assembly of the present invention.

FIG. **2** is a longitudinal sectional view of a single spool assembly of the bobbin assembly of the present invention.

FIG. **3** is a cross-sectional view of a spool assembly of the bobbin assembly of the present invention taken along lines III—III of FIG. **2**.

FIG. **4** is an end view of the bobbin assembly of the present invention mounted in a fixture for measuring the rotational resistance of the supply reel.

BEST MODE FOR CARRYING OUT THE INVENTION

A bobbin assembly for simultaneously dispensing a plurality of wires and controllably maintaining a predetermined tension of low magnitude on the wires is generally indicated by the reference numeral **10**. In the preferred embodiment, the bobbin assembly **10** includes a plurality of spool assemblies **12**, as shown in FIG. **1**, mounted on a single shaft **14**. Each of the spool assemblies **12**, as shown in FIGS. **2** and **3**, include a hub **16** mounted on the shaft **14**, a pair of bearings **18,18'** mounted on the hub **16**, a reel **20** rotatably mounted on the bearings **18,18'**, and a brake assembly as generally indicated by the reference numeral **22** positioned radially inwardly of the reel **20**. A means **24** for maintaining the hubs **16** in a fixed relationship with respect to the shaft **14** includes a nut **26** threadably mounted on each end of the shaft **14**. The nuts **26** are tightened, or drawn toward each other, thereby drawing all of the hubs **16** into an abutting relationship with respect to each other. The hubs **16** are maintained in a fixed relationship with each other and with the shaft **14** by the restraining action provided by the tightened end nuts **26**.

The hub **16** includes a radial flange **28** having a plurality of circumferentially spaced recesses **30** formed in a radial wall **32** of the flange **28**, a threaded end portion **34**, and a plurality of flat surfaces **36** formed on a centrally disposed cylindrical body portion.

The reels **20** include, as viewed in FIG. **2**, a left half portion **38** and a right half portion **40** joined by a plurality of bolts **42**. The left half portion **38** includes a

stepped bore which, when joined with the right half portion **40**, forms an annular slot **44** extending radially outwardly from the internal bore of the reel **20**, exposing a portion of the bolts **42**. The right half portion **40** of the reel **20** includes a radially oriented aperture **46** extending between the inner and outer surfaces of a central cylindrical portion, and an axially oriented aperture **48** extending between the radial walls of a flange portion of the right half portion **40**.

The brake assembly **22** includes a first reaction member **50** and a spaced second reaction member **52** both axially slideably mounted on the hub **16**, a friction member **54** axially disposed between the first and second reaction members **50,52**, and a means **56** for controllably, axially biasing at least one of the reaction members **50,52** toward one another and toward the friction member **54**. The pair of reaction members **50,52** are preferably formed of steel and having a plurality of circumferentially spaced flat surfaces **58** formed on the inner periphery of the members **50,52** mating with the flat surfaces **36** formed on the central body portion of the hub **16**. The first and second reaction members **50,52** are therefore axially moveable on the hub in a longitudinal direction along the shaft but are rotatably fixed with respect to the hub by engagement of the mating flat surfaces **36,58**. The friction member **54** is preferably formed of an internally lubricated thermoplastic, such as a nylon and molydenum disulphide composite material, and has a plurality of circumferentially spaced, radially extending tabs **60** which are notched to receive an exposed portion of the bolts **42**. Radial clearance is provided between the friction member **54** and hub **16**, and is self-positioning between the pair of reaction members **50,52**. The friction member **54** is therefore both axially and rotatably moveable with respect to the hub **54**, but rotatably fixed with respect to the reel **20** by engagement of the tabs **60** with the bolts **42**.

The biasing means **56** includes a plurality of circumferentially spaced springs **62** each respectively disposed in one of the recesses **30** formed in the flange **28** in an abutting relationship with the first reaction member **50**, and a collar **64** threadably mounted on the threaded end portion **34** of the hub **16**. The collar **64** has a plurality of axially oriented slots **66** formed on a radially outer surface of the collar **64**. The slots **66** are alignable with either of the apertures **46,48** provided in the reel **20**, enabling the collar to be selectively rotatably fixed with respect to the reel **20** by inserting an elongated pin or tool through the apertures **46,48** and into engagement with one of the slots **66**.

As shown in FIG. **4**, a tension calibration fixture **68** is provided for measuring the resistance to rotation of the reel **20**. The test fixture includes a motor **70** connected to the shaft **14** of a bobbin assembly **10** by a drive belt **72**, and a dial indicator force gage **74** having a hook **76** adapted for engagement with a notch **78** provided on the outer periphery of at least one of the flange portions of the reels **20**.

INDUSTRIAL APPLICABILITY

After assembly, as shown in FIG. **2**, a plurality of spool assemblies are mounted on the shaft **14**, and the nuts **26** are tightened to secure each of the hubs **16** in a fixed relationship on the shaft. The complete bobbin assembly **10**, as shown in FIG. **1**, typically includes five spool assemblies, each of which, after calibration and adjustment of the individual brake assemblies **22**, will be filled with a supply of wire, not shown, from a bulk supply source.

In a typical application, a 12.7 mm ($\frac{1}{2}$ in.) dia. high pressure hose requires 75 to 90 individual strands of 0.3 mm (0.012 in.) dia. wire circumferentially applied at predetermined angles over one or more layers of elastomeric material previously formed over a mandrel. The 75 to 90 strands of wire are typically supplied from about 15 to 18 of the bobbin assemblies **10**, each bobbin assembly **10** being mounted on a shuttle which rotates about the hose. As described above, it is desirable to maintain a constant torque force between the reel **20** and the shaft **24** and thereby maintain a predetermined tension on each of the 75 to 90 wires during application to the article. It has been found that a wire tension for wire delivered from a full bobbin of about 3 to 4 N (0.7 to 0.9 lbs.) on the wire is desirable.

The assembled bobbin assembly **10** is mounted on the tension calibration fixture **68** with the drive belt **72** operatively engaging the shaft **14** of the bobbin assembly **10**. The motor **70** is started and operated at speeds sufficient to rotate the shaft **14** in a counter-clockwise direction as viewed in FIG. **4**, at a typical operating speed as wire is dispensed from the reel **20** to an article being constructed. Typically, this speed will be about 9 to 18 rpm.

The pull, or resistance to rotation, exerted by each of the reels **20** of the bobbin assembly **10** is measured by engaging the hook **76** of the dial indicator force gage **74** into the notch **78** provided on each of the reels **20**. The amount of torque force transmitted from the rotary shaft **14** to the reel is controlled by adjusting the collar **64** and thereby axially moving the reaction members **50,52**. For example, if the indicator reading shows that the amount of pull exerted by the reel should be increased, a pin or similar elongated tool, is inserted through one of the apertures **46,48** provided in the reel and placed into engagement with one of the slots **66** formed in the collar **64**. The coupled reel **20** and the collar **64** are then rotated together in a direction to cause the collar **64** to move the second reaction member **52** towards the first reaction member **50** and thereby increase the frictional contact between the reaction members **50,52** and the friction member **54**. Conversely, if the amount of pull exerted by the reel **20** should be reduced, the coupled reel and collar are rotated in an opposite direction to that above to decrease the frictional contact between the respective reaction members **50,52** and friction member **54**.

It should be noted that the radially oriented aperture **46** is particularly useful for adjusting the collar on empty reels of a multiple spool bobbin assembly. The axially oriented aperture **48** is provided if it should be necessary to adjust the tension of a reel **20** containing a predisposed supply of wire. In the latter case, it is necessary to place the desired spool assembly **12** at an end of the bobbin assembly, or alternatively arrange as a single spool on a shaft, to permit access to the axially oriented aperture **48**.

In the end view of the tension calibration fixture shown in FIG. **4**, only a single dial indicator force gage **74** is visible. It should be recognized that for multiple spool bobbin assemblies it is desirable to provide a dial indicator **74** and an attached hook **76** for each reel of the assembly. This practice eliminates the need to reposition the dial indicator **74** for each reel **20** of the bobbin assembly **10** and therefore decreases the time required for adjustment of each of the collars **64**.

Other aspects, objects and advantages of this invention can be obtained from a study of the drawings, the disclosure and the appended claims.

What is claimed is:

1. In a bobbin assembly (10) for simultaneously dispensing a plurality of wires and controllably maintaining a predetermined tension on said wires, said assembly (10) having a shaft (14), and a plurality of reels (20) rotatably mounted on said shaft (14), the improvement comprising:

a plurality of hubs (16) each including a radial flange (28) having a plurality of circumferentially spaced recesses (30) formed in a radial wall (32) of said flange (28), each of said hubs (16) being removably mounted on said shaft (14) and positioned between said shaft (14) and a respective one of said reels (20);

means (24) for maintaining said hubs (16) in a fixed relationship with respect to said shaft (14);

first and second spaced reaction members (50,52) mounted on each of said hubs (16), at least one of said reaction members (50,52) on each hub (16) being axially moveable along the shaft (14) and each of said reaction members (50,52) being rotatably fixed on each hub (16);

a friction member (54) axially disposed between each of said first and second reaction members (50,52), each friction member (54) being axially moveable with respect to said hub (16) and rotatably fixed with respect to said reel (20); and,

means (56) for controllably, axially biasing at least one of said reaction members (50,52) toward said respective friction member (54).

2. The bobbin assembly (10), a set forth in claim 1, wherein said assembly (10) includes a plurality of springs (62) respectively disposed in each of said recesses (30) in an abutting relationship with said first reaction member (50), and a collar (64) threadably mounted on said hub (16) in an abutting relationship with said second reaction member (52).

3. The bobbin assembly (10), as set forth in claim 2, wherein said collar (64) includes a slot (66) formed on a radially outer surface of said collar (64), and said reels (20) each include a radially oriented aperture (46) and an axially oriented aperture (48), said apertures (46,48) being alignably disposed with respect to said slot (66) formed in said collar (64).

4. The bobbin assembly (10), as set forth in claim 1, wherein said friction member (54) is formed of an internally lubricated thermoplastic material.

5. The bobbin assembly (10), as set forth in claim 4, wherein said friction member (54) is formed of a nylon and molybdenum disulphide composite material.

6. A bobbin assembly (10), comprising:

a shaft (14);

a plurality of hubs (16) removably mounted on said shaft (14);

means (24) for maintaining said hubs (16) in a fixed relationship with respect to said shaft (14);

a plurality of reels (20) each rotatably mounted on a respective hub (16);

a pair of reaction members (50,52) mounted on each of said hubs (16), said reaction members (50,52) being axially moveable along the shaft (14) and rotatably fixed with respect to said hub (16);

a friction member (54) axially disposed between each of said pair of reaction members (50,52), said friction member being axially and rotatably moveable with respect to a respective one of said hubs (16) and rotatably fixed with respect to a respective one of said reels (20); and,

means (56) for controllably, axially biasing at least one of said reaction members (50,52) toward one another.

7. The bobbin assembly (10), as set forth in claim 6, wherein said hub (16) includes a radial flange (28) having a plurality of circumferentially spaced recesses (30) formed in a radial wall (32) of said flange (28), and said means (56) for axially biasing said pair of reaction members (50,52) includes a plurality of springs (62) respectively disposed in each of said recesses (30) in an abutting relationship with one of said pair of reaction members (50,52), and said assembly (10) includes a collar (64) threadably mounted on said hub (16) in an abutting relationship with the other one of said pair of reaction members (50,52).

8. The bobbin assembly (10), as set forth in claim 7, wherein said collar (64) includes a slot (66) formed on a radially outer surface of said collar (64), and said reels (20) each include a radially oriented aperture (46) and an axially oriented aperture (48), said apertures (46,48) being alignably disposed with respect to said slot (66) formed in said collar (64).

9. The bobbin assembly (10), as set forth in claim 6, wherein said first and second reaction members (50,52) are formed of metal, and said friction member (54) is formed of an internally lubricated thermoplastic material.

10. The bobbin assembly (10), as set forth in claim 9, wherein said friction member (54) is formed of a nylon and molybdenum disulphide composite material.

11. A spool assembly (12), comprising:

a shaft (14),

a hub (16) having a radial flange (28), said hub (16) being removeably attached to said shaft (14);

a reel (20) having a radially oriented aperture (46) and an axially oriented aperture (48), said reel (20) being rotatably mounted on said hub (16);

a pair of reaction members (50,52) mounted on said hub (16) radially inwardly of said reel (20), said reaction members (50,52) being axially moveable and rotatably fixed with respect to said hub (16);

a friction member (54) mounted on said reel (20) radially inwardly of said reel and positioned between said pair of reaction members (50,52), said friction member (54) being axially moveable with respect to said hub (16) and rotatably fixed with respect to said reel (20);

a plurality of springs (62) disposed in a circumferentially spaced relationship between the radial flange (28) of said hub (16) and one of said pair of reaction members (50,52); and,

a collar (64) threadably mounted on said hub (16) in an abutting relationship with the other one of said pair of reaction members (50,52) and having a slot (66) formed on a radially outer surface of said collar (64), the radially oriented aperture (46) and the axially oriented aperture (48) of said reel (20) being alignably disposed with respect to said slot (66).

12. The spool assembly (12), as set forth in claim 11, wherein said pair of reaction members (50,52) are formed of a metallic material and said friction member (54) is formed of an internally lubricated thermoplastic material.

13. The spool assembly (12), as set forth in claim 12, wherein said pair of reaction members (50,52) are steel, and said friction member (54) is formed of a nylon and molybdenum disulphide composite material.

* * * * *